DOCUMENT RESUME

ED 260 939 SE 045 979

AUTHOR Buethe, Chris
TITLE The Status of Indiana Teachers' Environmental Knowledge and Attitudes.
SPONS AGENCY Indiana State Univ., Terre Haute.
PUB DATE 85
NOTE 35p.; Study was conducted with support from the Indiana State University Research Fund.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Elementary School Teachers; Elementary Secondary Education; *Energy Education; *Environmental Education; *Knowledge Level; Questionnaires; Secondary School Teachers; Semantic Differential; State Surveys; *Teacher Attitudes; Teacher Background
IDENTIFIERS *Environmental Attitudes; Environmental Literacy; *Indiana

ABSTRACT

This study investigated the capability of Indiana elementary and secondary school teachers to deal effectively with education about the environment and related energy issues. Questions addressed were: (1) What do Indiana teachers know about their physical environment? (2) How do Indiana teachers feel about the environment? and (3) How do the teachers' responses compare to those given by teachers a decade ago? Recently certified elementary and secondary teachers were randomly sampled by mail and data was compiled on 204 respondents. Teachers provided information on personal and professional backgrounds and completed a two-part knowledge-related scale on energy/environmental terms, concepts, and problems. A third part of the survey was designed to indicate the feelings and attitudes of these teachers toward 21 selected energy/environmental expressions (using a semantic differential format). Analysis of the results reveal that current teachers know too little about energy and the environment but know somewhat more than their counterparts in 1974-75. It is indicated that Indiana teachers are caring, but are only partially literate regarding energy and the environment. (An appendix contains the complete survey instruments.) (ML)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED260939

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

THE STATUS OF INDIANA TEACHERS' ENVIRONMENTAL KNOWLEDGE AND ATTITUDES

Dr. Chris Buethe

Professor of Secondary Education

Indiana State University

Terre Haute, Indiana

1985

This study was conducted with support from the Indiana State University Research Fund, on the recommendation of the University Research Committee.

SE 045 979

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Chris Buethe
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Acknowledgements

A number of professional educators and environmental/energy specialists contributed to this study, conducted with the support of a Research Grant from Indiana State University.

John Harrold, Director of the Division of Curriculum, and Joe Wright, Science Education Consultant, aided the project through the State Department of Education.

Many terms were suggested by Science Professors Walter Carnahan, John Corrigan, James Lee Guernsey, Marion Jackson, and Marshall Parks of Indiana State University. Additional help was given by John Fowler and the National Science Teachers Association, Ralph Llewellyn, Central Florida University, selected faculty from the Ohio State University, and John Hernandez, New Mexico State University.

Graduate assistants Thomas Isekenegbe and Jorge Olaves, Indiana State University, School of Education, assisted with the project. Anna Rosalie Carson added needed test analyses. All of the above plus the participating teachers are appreciated.

Introduction

Many Indiana teachers were found to be environmentally illiterate during a 1975 study. Half of 70 selected environmental terms were known by fewer than 90% of the randomly selected teachers in the study a decade ago. Half did not know the meaning of terms like *"hydrocarbon"*, *"temperature inversion"*, and *"scrubber"*, and one-fourth did not know the meaning of *"fossil fuel"* and *biodegradable"*. One in seven believed that most Indiana electricity comes from waterfalls and rivers.

These teachers and their counterparts influence thousands of Indiana residents through information and/or misinformation and attitudes regarding their physical environment. In 1985, a decade later, questions continue to be raised about the capability of Indiana - and U.S. - elementary and secondary teachers to deal effectively with education about the environment and related energy issues.

Two assumptions underlie this comparative study:

(1) All teachers are at times environmental/energy educators, and

(2) Teachers teach mainly in terms of what they know and what they value.

The current study investigated basic questions:

1. What do Indiana teachers know about their physical environment?
2. How do Indiana teachers feel about their environment?
3. How do their related responses compare to those given by teachers a decade ago?

Method and Procedure.

Nearly five hundred currently certified elementary and secondary teachers in the state of Indiana were randomly sampled by mail. The initial group of five hundred was diminished by approximately two percent through normal historical attrition from the profession. A total of 204 (slightly more than 40%) responded, and their information was included in the analyses of data. The instruments utilized, parts A, B, and C are shown in the Appendix.

Respondents were asked to supply information on six personal and professional characteristics: age group, sex, marital status, teaching level, discipline taught, and school setting. Since not all teachers indicated each of the six characteristics or answered all questions, some different totals resulted for each subset. An analysis of the demographic information supplied appears in Table 1.

Table 1

DISTRIBUTION OF TEACHERS BY CHARACTERISTICS

Elementary	99		Secondary		120
Male	75		Female		149
Married	139		Unmarried		27
Urban	78		Rural		67
Discipline	Science	24	Age:	(20-29)	30
	Social Studies	26		(30-39)	66
	Other	102		(40-49)	39
				(50+)	44

Two scales were completed by the teachers sampled. The scales were developed by Dr. Chris Buethe, professor of education at Indiana State University, based upon suggestions from ten advisor/judges, all recognized environmental/energy educators. The first scale included two parts which measured the extent of knowledge of selected environmental and related energy terms and concepts. Part A of the first scale included a list of 70 energy/environmental terms, most of which were chosen because they were (a) little known by participants in a similar 1975 study or (b) were nominated by two or more of the ten project advisors. On Part A, each responding teacher indicated his/her present degree of understanding of each of 70 terms by marking (A) I know what the term means, (B) I recognize the term, but I don"t know what it means, or (C) I have never heard of the term. Response categories (B) and (C) were grouped together for the analysis of results of PART A: Environmental/ Energy Terms.

For example, the term *"energy"*; energy is the capacity to do work. It is assumed that a teacher who was familiar with the meaning of energy marked "A" on the answer sheet, and that a teacher who marked either "B" or "C" did not know the meaning of the term.

Part B included 28 multiple-choice items dealing with knowledge of environmental and energy facts, problems, and concepts, plus two self-rating items. Teachers were asked to mark the choice that corresponded to the best answer in each case. For example, "The first one of these to decay when buried in the ground is a(an): (A) glass bottle, (B) *"tin"* can, (C) aluminum can, or (D) plastic bottle." Since a *"tin"* can is the first one of these to decay when buried in the ground, the answer is choice "B".

The second scale[1] (Part C) was designed to indicate the feelings and attitudes of teachers toward 21 selected energy/environmental expressions like "*nuclear energy*," "*treated sewage*," "*strip mine*," and "*no smoking zone*." The qualifier pairs "*good -- bad*" and "*wise -- foolish* were utilized to help assess the semantic judgments of teachers toward each of the twenty-one expressions. Twelve of the expressions included were repeated from the 1975 Indiana study, while nine were newly added.

Seven steps were differentiated between the bipolar qualifiers like "*bad-good*", and teachers were asked to place a check mark on the position that best described their feelings and attitudes, i.e. to indicate whether a term was extremely related, quite related, slightly related, or not related (neutral).

The environmental scales, a computer answer form, a self-addressed and prepaid return envelope, an optional post card to be completed if a summary of the major findings of the study was desired, and a cover letter made up the set of materials mailed to each teacher. A support letter from John A. Harrold, Director of the Indiana Division of Curriculum, State Department of Education, was also included. (See Appendix). Following a brief period, a duplicate packet of materials with a new cover letter was mailed to insure the return of more data.

Returns were encoded with demographic information available, and data processed by the Indiana State University Testing Division.

---

[1]The scale is based in part on a model presented by Snider and Osgood in Semantic Differential Technique, Chicago, Illinois, Aldine Publishing Co., 1969.

Limitations of the Study

Most questions and vocabulary items that made up the instruments were based upon work previously conducted by the investigator in Indiana (1974-1975). They were based upon the advice of environmental education specialists from seven disciplines in both 1974 and in 1984. The short, non-standardized instruments utilized contain some questions that may lack curricular validity for specific Indiana school and community settings. However, attempts were made to update questions to 1984 environmental and energy issues through careful analysis of news media as well as education journals. Inclusion of terms and concepts that were repeatedly mentioned in leading U.S. and Indiana publications may compensate for some lack of standardization.

It is recognized that any self-check of vocabulary recognition may yield inaccurate and possibly inflated results. Environmental/energy literacy of Indiana teachers may be lower than has been indicated by the results of this study. Teachers who elect to respond to lengthy questionnaires may be atypical of the set of all teachers. It is not known whether non-respondents know the same, more, or less than respondents; one may cautiously guess that conscientious teachers try to be helpful on studies and that they are <u>at least</u> as well informed as their colleagues.

A forty-plus percent return on the questionnaire/self tests of this study is a disappointment, in view of the fact that fifty-five percent responded to a similar study in 1975. However, with large N's (more than 200), it is likely that the information gathered is sufficiently useful, though gathered over a period of five months.

Results

Part A: Environmental/Energy Terms (vocabularly recognition)

Half of the selected environmental and energy terms were known by fewer than 90% of the teachers sampled. The thirty least recognized terms were ranked from least to most known and appear in Table 2.

Table 2

ENVIRONMENTAL/ENERGY TERMS NOT KNOWN
BY INDIANA TEACHERS

Term	Percent NOT Knowing Term's Meaning
non-point source	97%
albedo	94%
Global 2000	94%
quad (energy term)	94%
pyrolysis	91%
catalytic converter	90%
eutrophication	88%
dioxin	87%
EDB	87%
entropy	85%
NO_x	85%
insolation (not insulation)	81%
mutagen	76%
photovoltaic	76%
ambient	74%
baseload	72%
superfund	69%
biomass	65%
particulate	65%
biosphere	56%
gasification	53%
estuary	52%
biotechnology*	50%
breeder reactor	50%
effluent	50%
scrubber	48%
precipitator	45%
temperature inversion	45%
environmental impact statement	43%
leaching	43%

*Half of the teacher respondents indicated that they did not know the meaning of the term "biotechnology" or had never heard of the term.

Comparisons by Decade

Twenty five environmental terms that are used by the common media as well as environmental education writers were unknown to many Indiana teachers in the 1975 study that parallels the current one. To help answer the question: "Are today's Indiana teachers more environmentally literate than those of a decade ago?" The 25 terms were reselected for use in Part A of this study. Table 3 gives a direct comparison of results, and shows that in 22 of 25 cases, today's Indiana teachers appear to be more familiar with environmental vocabulary than were their counterparts. In some cases, gains are quite dramatic, showing a growing awareness of terms like *EPA, ozone, hydrocarbon, greenhouse effect, sulfur dioxide, biodegradable, herbicide, fossil fuel, and food chain.* Within the limitations of this study, one may be heartened by the Part A results when contrasting them to those of a decade ago.

Table 3

ENVIRONMENTAL/ENERGY TERMS NOT KNOWN
BY INDIANA TEACHERS

Term	Percent NOT Knowing Term's Meaning	
	1975	1985
particulate	72%	65%
fly ash	68%	69%
gasification	67%	53%
biosphere	66%	56%
scrubber	61%	48%
effluent	52%	50%
precipitator	51%	45%
temperature inversion	51%	45%
hydrocarbon*	50%	35%
leaching	47%	43%
greenhouse effect	47%	15%
EPA	47%	15%
ozone	40%	7%
sulfur dioxide	33%	18%
plankton	29%	21%
aeration	28%	25%
reclamation	28%	24%
biodegradable	25%	11%
fossil fuel	25%	6%
bituminous	24%	26%
herbicide	24%	3%
decibel	20%	27%
runoff	19%	14%
watershed	19%	17%
food chain	17%	5%

*In the 1975 Indiana study, half the teachers indicated that they did not know the meaning of the term "hydrocarbon"; a decade later, 35% so indicated.

A general analysis was made of the number of environmental/energy terms recognized by teachers possessing different characteristics. It was expected, based upon the 1975 study, that science teachers, males, and possibly older teachers would indicate greater knowledge of environmental terms than would social studies teachers, females, and younger teachers. Differences based upon sex, location, and marital status were not expected.

Table 4

INDICATED KNOWLEDGE OF 70 ENVIRONMENTAL/ENERGY TERMS
COMPARING INDIVIDUAL TEACHER CHARACTERISTICS

VARIABLE		NUMBER OF ENVIRONMENTAL TERMS KNOWN			
		0 to 17	18 to 35	36 to 53	54 to 70
SEX	MALE**	1	9	38	24[a]
	FEMALE	3	44	46	8
MARITAL STATUS	MARRIED*	3	40	66	27
	UNMARRIED	1	15	7	5
TEACHING LEVEL	ELEMENTARY	1	38	51	10
	SECONDARY**	3	18	29	21
DISCIPLINE	SCIENCE**	0	2	6	16
	SOCIAL STUDIES	1	6	13	5
	OTHER	3	38	46	11
LOCATION	URBAN	3	29	33	15
	RURAL	1	17	36	13
AGE	20-29	1	12	14	3
	30-39	2	23	32	9
	40-49	0	13	14	11
	50+	1	8	24	10

[a] 24 of the male teachers responding knew 54 to 70 of the 70 selected terms.

From chi-square analysis, statistically significant differences are shown to exist, as noted.

* = $p<0.05$; ** = $p<0.01$

In Table 4, differences between responses within variables are shown. Statistically significant differences appear with respect to four of the six factors considered. Male respondents indicated a significantly higher level of term recognition than did females. Married teachers recognized more environmental and energy terms than did unmarried teachers. Secondary teachers had significantly higher recognition levels than did elementary teachers. Science teachers outscored social studies and other teachers by wide margins, as expected. No significant differences were revealed in urban-rural location of teachers, and little difference was noted between age groups, although the lowest term recognition marks were achieved by the youngest of the four age groups.

A composite of the environmental term-literate Indiana teacher in this study appears to be a secondary level, male science teacher who is married and beyond the age of thirty.

Results:

Part B: Environmental/Energy Problems and Concepts.

Twenty-seven multiple-choice questions about environmental and energy related problems and concepts were utilized in obtaining mean scores and analyses of individual items. Sixteen questions had been part of a similar Indiana study a decade ago, and were included here in order to make further literacy comparisons. Useful returns from 203 teachers yielded overall mean scores of slightly less than 65% on the non-standardized Part B scale. Analysis of variance techniques indicated no statistically significant differences between scores by groups indicating urban or rural location or between four different age groups. On two categories, teaching level and marital status, significantly higher scores were made by secondary teachers and by teachers

who were married. Highly significant differences were indicated in relation to teaching field and teachers' sex, with males and science teachers achieving much higher scores than females and teachers of nonscience subjects. Related F ratios and other data appear in Table 5.

Table 5

ENVIRONMENTAL/ENERGY PROBLEMS AND CONCEPTS

Variable	Value	Mean	Std. Dev.	N	F
Teaching Level	Elementary	16.78	3.[illegible]	97	5.93*
	Secondary	18.31	4.[illegible]1	70	
Sex	Male	18.65	4.58	74	12.73**
	Female	16.51	3.33	99	
Location	Urban	17.42	4.40	78	0.06
	Rural	17.60	3.94	67	
Marital Status	Married	17.75	3.88	138	5.97*
	Unmarried	15.67	4.83	27	
Age Group	20-29	16.13	3.50	30	2.23
	30-39	17.00	4.95	66	
	40-49	18.29	2.92	38	
	50+	18.05	3.49	44	
Teaching Field	Science	20.91	2.79	23	11.25**
	Social Studies	17.48	5.16	25	
	Other	16.62	3.78	100	

*significant ($p < 0.05$)
**highly significant ($p < 0.01$)

ANOVA: Summaries by variable

An analysis of individual items pointed out some differences of apparent teachers' familiarity with specific energy and environmental problems. Table 6 rank orders the most unfamiliar questions of the study reported in 1975. Comparisons are shown to the responses of teachers in this 1984-1985 study. The

instrument Part B is not standardized, and questions are of uneven difficulty. However, viewing teacher responses to the same questions over time may yield valuable cues. While most teachers know that trees are the source of much paper, many teachers are less literate in other energy/environmental areas.

Table 6

ENERGY/ENVIRONMENTAL LITERACY COMPARISONS

Concept Cue	Percent of Teachers Who Did NOT Know	
	1975 (N=271)	1985 (N=203)
Rate of Fossil Fuel Use	82%	83%
1990 Energy Source	77%	44%
Efficient Auto Speed	68%	63%
Wabash Watershed	57%	61%
Water Hardness Cause	49%	51%
Shale Oil Region	41%	46%
Fireplace Efficiency	40%	16%
Sun as Energy Source	39%	33%
Noise-Induced Deafness	34%	25%
Food Chain	31%	23%
Ecology Defined	31%	18%
Degradable Solid Waste	26%	23%
Electrical Use Peaks	24%	23%
Coal Fuel Reserves	23%	20%
Indiana Electricity Sources	21%	15%
Paper from Trees	4%	3%

The above table begins with the least known problem or question from the Part B scale, as reported in 1975. i.e./82% of the 271 responding teachers were not able to correctly choose the appropriate answer from a set of four given choices; a decade later, 83% missed the same question.

Item analyses indicate that teachers appear to have gained familiarity with some selected environmental and energy problems. However, most teachers still grossly underestimate the rate at which Indiana residents consume fossil fuels compared to the world averages.

Table 7

TEACHER RECOGNITION OF SELECTED ENERGY/ENVIRONMENTAL CONCEPTS
(Newly added, Not used in 1975 Study)

Concept Cue	Percent of Teachers Who Did NOT Know
U.S. Agriculture Water Use	76%
Silicon in Fuel Cell	60%
Energy Efficiency Ratio	55%
Indiana Nuclear Plants in Use	52%
Indiana Gasohol Content	50%
EDB - Toxic	50%
Coal - Acid Rain Assumption	28%
Name of EPA Director (then from Indiana)	26%
Carcinogen's Effect	15%
Tobacco - Cancer Link	4%

A review of Tables 6 and 7, which show related information, reveals that over half of the respondents did not recognize the contents of gasohol, and over half assumed that Indiana has nuclear power plants in use. (It does not). Half were unable to identify EDB as a toxic substance, and more than half were unable to identify a simple energy efficiency ratio. Nearly two-thirds incorrectly identified an efficient auto operating speed, and most could not identify the geography and/or function of a watershed in their state. Causes of hard water were unknown to over half of the teachers.

Some unusual answers were selected. More than 30% failed to choose the sun as the principal source of energy, instead naming the atmosphere, water, or dirt. Fifteen percent did not recognize that a carcinogen causes cancer. Twenty-six percent did not recognize the name of the E.P.A. head, although at the time of the investigation, he was a well-known Indiana native.

Despite the above comments, there is a positive note. It appears that Indiana teachers now are more familiar with many environmental/energy concepts and problems than were their counterparts ten years ago. As indicated in the comparison columns of Table 6, many gains have been made.

Teachers Grade Themselves

Each teacher was asked to compare his/her knowledge about energy/environmental problems with that of other teachers, and to "grade" himself on knowledge and awareness. Results of self-grading indicate that most teachers do not consider themselves to be well informed. (3% A's) However, they see themselves as knowing as much as other teachers. (50% indicate the same level of knowledge)

Table 8

SELF EVALUATION REGARDING ENERGY/ENVIRONMENTAL AWARENESS

Item #99: "With regard to environmental/energy problems and solutions, compared to other Indiana teachers I know . . ."	More	Less	The Same	Nothing
	13%	33%	52%	2%
Item #100: "On a scale of A,B,C, --, I give myself the following 'grade' on knowledge and awareness of environmental/energy problems and solutions . . ."	A	B	C	D
	3%	40%	51%	6%

Indiana teachers, through responses to Part B of the self-test/questionnaire, have indicated that many energy and environmental concerns are unfamiliar to them, and through their self-ratings, they have indicated an awareness of their limited literacy and that of their colleagues.

Results

Part C: ATTITUDES (INDIANA ENVIRONMENT)

Teachers were asked to place check marks on each segmented scale that spanned selected word pairs like

Good _____:_____:_____:_____:_____:_____:_____:_____:_____:_____ *Bad*

In that way, they related their feelings about each of twenty-one expressions that were related to energy and/or environment. Part C was designed to yield factors for semantic differential analysis. For the purpose of this study, two scales were utilized for each of the twenty-one expressions: *wise-foolish*, and *bad-good*. Each scale contained seven identifiable segments, with the middle segment defined as neutral. The analysis of results is based upon the assignment of linear directional values -3 -2 -1 0 +1 +2 +3, with a maximum total of +6 possible when combining values from the two scales.

Table 9

COMPARISONS OF TEACHER ATTITUDES
TOWARD SELECTED ENERGY/ENVIRONMENTAL EXPRESSIONS

(+6.00 = Maximum Support; 0 = Neutral; -6.00 = Maximum Opposition)

Expression	Mean Response, 1975	Mean Response, 1985
Clean Environment	+5.31	+5.09
Treated Sewage	+5.07	+4.78
Birth Control	+4.50	+4.14
Technology	+4.15	+3.97
Nuclear Energy	+3.55	+1.21
Emission Control	+3.38	+3.72
Electric Heating	+2.78	+1.05
Auto Weight Tax	+1.15	+0.47
Industrial Water Use	+0.38	+0.95
Agricultural Pesticide	+0.35	+0.70
Factory Effluent	-1.36	+0.24
Strip Mine	-1.68	-0.31

Table 9 indicates that Indiana teachers strongly support a clean environment as both "wise" and "good", as they did in the 1975 study. Attitudes appear to have changed most regarding the worth of nuclear energy and electric heating. Factories and strip mines have become viewed more positively than previously, and heavy cars appear to be acceptable today.

New terms were added to the 1975 set, and are included in the Table 10 data that follow. The strong support for No Smoking Zones and relatively strong support for a 55 mph Speed Limit appear to be positive indicators of the environmental concerns of the teacher participants in the study.

Table 10

INDIANA TEACHERS' ATTITUDES TOWARD ENERGY/ENVIRONMENTAL EXPRESSIONS

(+6 = Maximum Support; 0 = Neutral; -6 = Maximum Opposition)

Expression	Mean of Teachers' Responses
Energy Alternative Research	+5.00
No Smoking Zone	+4.64
Family Garden	+4.35
Solar Heating Tax Break	+4.04
55 mph Speed Limit	+3.88
Wood-Burning Stove	+1.47
Coal-Fired Power Plant	+1.08
Fuel Rationing	-1.00
Food Coloring	-1.54

Table 10 indicated that Indiana teachers in this most recent study supported Family Gardens and viewed Food Coloring skeptically.

Summary

The analysis of results of this study yields a partial profile of Indiana teachers' knowledge and attitudes about environmental and energy related problems and proposed solutions.

Teachers know too little, and they recognize that shortcoming. However, today's 1984-1985 teachers know somewhat more about environmental and energy concerns than did their counterparts in 1974-1975. There also appears to have been a shift toward more realistic viewpoints of economic-environmental-energy interconnections.

As expected, science teachers appear to be relatively well informed about their physical environment. This is indicated by the results of each part of the study. Social studies teachers, although better informed than other non-science teachers, appear to have serious gaps in their environmental/energy literacy. The profile of the least informed teacher is apparently one who is a young, unmarried, elementary teacher with little background in science.

In general, some basic relationships appear to be unknown to most teachers. Indiana teachers underestimate the rate of fossil fuel use, fail to recognize energy information about their own state, assume that highway auto speeds are the most efficient, do not recognize the causes of hard water or the placement of one of their state's principal watersheds. They are unfamiliar with energy efficiency ratios, the contents of gasohol, the continued reliance of the U.S. upon petroleum, and other related factors.

Teachers indicate that they want a clean environment. They tend to be pro-technology, and appear to have shifted to some acceptance of the needs of and for industry. They endorse birth control, are cautious about smoking and food coloring, and supportive of family gardens and energy alternative research.

The results of the investigation indicate that Indiana teachers are caring, but are only partially literate regarding energy and their environment.

Conclusion and Implications

All teachers should be well informed about their physical environment and energy issues, because each teacher is entrusted with informing students and implanting values. Each teacher helps to establish attitudes toward the finite earth and its limited resources, so each needs to know.

Science teachers, who deal most with the formal content of this study are better informed than their colleagues from social studies and other disciplines. Specific curriculum emphasis upon energy/environment has subsided in recent years, but science teachers are expected to include related teaching in their basic courses. With Indiana and other states expanding science course offerings/and requirements, opportunity exists to expand teaching about energy/environment. Even science teachers will need updates.

When teachers are only partially informed, as this study suggests, it is likely that their students will be unable to benefit from high quality instruction about energy and the environment. Non-science teachers, especially at the elementary level, appear to be in the best position to influence pupils toward constructive environmental views, and apparently are least prepared via content knowledge to do so.

As a result of this study, it is suggested that, with respect to energy and environmental education,

1. The situation is improving, but Indiana teachers still need help, especially with content information.

2. Local school science teachers may be able to serve as peer teachers about energy/environment, since they are relatively well informed. (Three projects conducted by this investigator suggest that high level science students can also teach effectively when dealing with younger students; O.E.E. 1976-1977-1978, D.O.E., 1980-1981.)

3. A cost-effective energy/environmental education update should be conducted with Indiana teachers, focusing upon key issues, vocabulary development, removal of misconceptions, and alternative solutions. State Universities and the State Department of Education can lead this.

This investigation reveals a problem: Indiana teachers need new content knowledge about energy and environmental concerns. The problem can be solved through cooperative efforts of individuals and agencies.

APPENDIX

State of INDIANA

Department of Public Instruction
Harold H. Negley, Superintendent
Room 229, State House • Indianapolis 46204
317/232-6610

Division of Curriculum
Room 229, State House
317/927-0111

M E M O R A N D U M

TO: Elementary and Secondary Educators

FROM: John A. Harrold, Director
Division of Curriculum

RE: Environmental Education

DATE: April 16, 1984

You have been selected by a random sampling process to participate in a research project which will assist the Indiana Department of Public Instruction and Indiana State University in determining the knowledge and attitudes Hoosier educators have toward the environment. The results from this study will be useful in designing future programs for Hoosier educators.

Since you were selected by the Department's Division of Educational Information and Research using the state computer to identify the sampled educators, your response is important in assuring that the results accurately reflect the attitudes and knowledge of Indiana educators. Please complete Parts A, B, and C in alphabetical order and return your data to Indiana State University this week. Your anonymity will be fully protected.

Thanks for taking time from your busy teaching schedule to participate in this project. If you wish a summary of the survey results, provide your name and address on the enclosed post card and return it with your completed survey.

JAH:lr

BEST COPY AVAILABLE

INDIANA STATE UNIVERSITY TERRE HAUTE, INDIANA 47809

DEPARTMENT OF SECONDARY EDUCATION (812) 232-6311

May 14, 1984

Fellow Educator:

Help! We need information from you.

We wish to plan environmental and energy education projects that help Indiana schools. In order to do that, we need a good estimate of your current knowledge and feelings about some related terms and ideas. As Dr. Harrold's memorandum indicates, your input is important.

Please contribute ~25 minutes of your valuable time by completing the enclosed "self-test" Parts A, B, and C within the week.

Return the IBM sheet and Part C in the enclosed envelope. If you wish to have a summary of the results of the study, please return your addressed post card. Your anonymity will be protected.

We realize that there are many demands upon your time, and appreciate your special contribution on behalf of Hoosier colleagues.

Professionally yours,

Chris Buethe

Chris Buethe
Professor of Education
Indiana State University

CB/lmu

Enclosure

BEST COPY AVAILABLE

INDIANA ENVIRONMENT

--Dr. Chris Buethe
Indiana State University

PART A: ENVIRONMENTAL/ENERGY TERMS

Directions: For each of the 70 terms listed below, indicate your present degree of understanding. On the separate answer sheet, shade in the space below each letter that corresponds to the BEST answer.

A. I know what the terms means.
B. I recognize the term, but I don't know what it means.
C. I have never heard of the term.

E.g.,"Energy" (I know that energy is the capacity to do work, therefore,

A. B. C.
■ □ □

1. acid rain
2. aeration
3. albedo
4. ambient
5. available work
6. BTU
7. baseload
8. biodegradable
9. biomass
10. biosphere
11. biotechnology
12. bituminous
13. breeder reactor
14. CO_2
15. carbon monoxide
16. carcinogen
17. catalytic converter
18. cogeneration
19. cost/benefit ratio
20. DOE
21. decibel
22. deforestation
23. dioxin
24. EDB
25. EPA
26. ecosystem
27. energy efficiency ratio
28. effluent
29. entropy
30. environmental impact statement
31. estuary
32. ethanol
33. eutrophication
34. fly ash
35. food additive
36. food chain
37. fossil fuel
38. fusion energy
39. gasification
40. Global 2000
41. greenhouse effect
42. habitat
43. heat pump
44. herbicide
45. high sulfur coal
46. horsepower
47. hydrocarbon
48. insolation (not insulation)
49. leaching
50. mutagen
51. NO_x
52. non-point source
53. OPEC
54. ozone
55. pH
56. particulate
57. photovoltaic
58. plankton
59. precipitator
60. pyrolysis
61. quad (energy term)
62. reclamation
63. runoff
64. scrubber
65. sulfur dioxide
66. superfund
67. temperature inversion
68. toxic waste
69. water table
70. watershed

BEST COPY AVAILABLE

PART B: ENVIRONMENTAL/ENERGY CONCEPTS

Directions: Continuing with your separate answer sheet, mark the letter that corresponds to the BEST answer in each case.

71. Air pollution in my city or the closest city comes mainly from

A. factories
B. homes
C. cars
D. other sources

72. The greatest amounts of electricity are used in homes between

A. 8:00 and 10:00 a.m.
B. noon and 2:00 p.m.
C. 3:00 p.m. and 5:00 p.m.
D. 5:00 p.m. and 7:00 p.m.

73. The first one of these to decay when buried in the ground is a (an)

A. glass bottle
B. "tin" can
C. aluminum can
D. plastic bottle

74. Of these the main US consumers of water quantities are industry and

A. public institutions
B. private homes
C. agriculture
D. mines

75. The paper on which this test is written was made from

A. animals
B. oils
C. trees
D. air

76. The study of living things and the way they live in their surroundings is called

A. environment
B. ecology
C. geometry
D. geography

77. Acid Rain is believed by most to be caused principally by burning

A. coal
B. jet fuel
C. tetraethyl lead
D. leaves

78. Most electricity used in Indiana comes from

A. burning fuel
B. waterfalls and rivers
C. atomic power plants
D. chemical batteries

79. Almost all the energy we use on the earth comes from (the)

A. water
B. sun
C. atmosphere
D. dirt

80. Gasohol is most likely to contain

A. 10% ethanol
B. 90% ethanol
C. 10% methanol
D. 90% methanol

81. A person can destroy part of his hearing by often

A. listening to loud music
B. driving large tractors
C. doing either of these things
D. neither of these

82. Much water that runs down the Wabash River comes from

A. rain in Illinois
B. rain in Kentucky
C. snow in Ohio
D. snow in Michigan

BEST COPY AVAILABLE

83. The number of nuclear power plants now operating in Indiana is closest to

A. 0
B. 1-2
C. 3-4
D. 5 or more

84. Of these, the poorest way to save fuel in homes is to

A. use fireplaces
B. use gas heat
C. turn thermostats down nights
D. insulate homes

85. "Hard" water contains compounds of

A. nitrogen and hydrogen
B. hydrogen and sulfur
C. sulfur and calcium
D. calcium and magnesium

86. Of these, most suspect as a cause of cancer is (a)

A. fibrous food
B. tobacco
C. bump or bruise
D. alcohol

87. Closest to the sun in the "food chain" is the protein in

A. beef
B. eggs
C. beans
D. cheese

88. Most used in making photovoltaic cells is the element

A. sodium
B. copper
C. silicon
D. aluminum

89. If a factory or power plant dumps large amounts of hot water into a stream,

A. germs will be killed, making the water safer
B. the amount of sediment carried by the stream will increase
C. less water will evaporate
D. fish may be killed or kept from spawning

90. The people of Indiana (approximately 1/2000 of the world's population) use approximately the following fraction of the world's fuels:

A. 1/2000
B. 1/1000
C. 1/500
D. 1/100

91. Of these auto speeds, the most efficient for gas mileage is

A. 14 miles per hour
B. 42 miles per hour
C. 56 miles per hour
D. 70 miles per hour

92. Of these sources of energy, the principal US supplier in the year 1990 will be

A. nuclear plants
B. solar space stations
C. geothermal heat pumps
D. petroleum

93. Of these, the largest fossil fuel reserves on the earth are found in

A. coal
B. peat
C. petroleum
D. natural gas

94. Shale oil recovery is most closely related to problems of environmental management in (the)

A. off-shore Gulf of Mexico
B. Colorado mountains
C. Alaskan tundra
D. North Atlantic Ocean

BEST COPY AVAILABLE

95. If a heat pump takes in (uses) 1 (one) electric power unit and gives out 5 heat energy units, its EER is said to be

A. 1/5
B. 25%
C. 4
D. 5

96. EDB is the acronym for a (one)

A. federal environmental agency
B. noise - induced hearing loss
C. toxic substance
D. gasoline substitute

97. Carcinogens are agents that are likely to produce

A. defoliation
B. dietary deficiencies
C. fuel alternatives
D. cancer

98. The current director of the US Environmental Protection Agency is

A. Anne Burford
B. John Hernandez
C. Rita LaVelle
D. William Ruckelshaus

99. With regard to environmental/energy problems and solutions, compared to other Indiana teachers I know

A. more
B. less
C. the same
D. nothing

100. On a scale of A, B, C, --, I give myself the following "grade" on knowledge and awareness of environmental/energy problems and solutions.

-(END OF PARTS A & B)-

Go on to Attitude Scale

BEST COPY AVAILABLE

INDIANA ENVIRONMENT

PART C: ATTITUDES

Please circle the appropriate responses that describe you:

Elementary	Secondary	Age:	20-29
Male	Female		30-39
Urban	Rural		40-49
Married	Unmarried		50 +

Discipline: Science Soc. Studies
Other

The purpose of this scale is to indicate your feelings and attitudes about selected environmental/energy concepts. This information will help to determine the extent of teacher awareness about related problems in Indiana.

HOW TO COMPLETE THE SCALE

In completing this instrument, make your judgments on the basis of what these environmental expressions mean to you. The direction toward which you check, of course, depends upon which of the two ends of the scale seem most characteristic of the expression you are judging. Make each item a separate and independent judgment. Work at a fairly high speed for it is your first impression, the immediate "feeling" about each item, that we want.

Examples:

If you feel that the environmental expression at the top of each section is very closely related to one or the other end of the scale, you might check as follows:

Good ✓ : : : : : : Bad

If you feel that the environmental expression is quite closely related to one or the other end of the scale (but not extremely), you might check as follows:

Foolish : : : : : ✓ : Wise

If the environmental expression seems only slightly related to one or the other side (but is not really neutral), then you might check as follows:

Bad : : ✓ : : : Good

If you consider the environmental expression to be neutral on the scale, i.e., both sides of the scale are equally associated with the expression, or if the scale is completely irrelevant, (unrelated to the expression), then you should place your check in the middle space:

Wise : : : ✓ : : Foolish

*The scale is based in part on a model developed by Snider and Osgood in Semantic Differential Technique, Chicago, Illinois: Aldine Publishing Company, 1969.

BEST COPY AVAILABLE

IMPORTANT: (1) Place your check-marks in the middle of spaces, not on the boundaries.

(2) Be sure you check each scale for each environmental expression--do not omit any.

(3) Put no more than one check-mark on a single scale.

CLEAN ENVIRONMENT

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

TREATED SEWAGE

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

ELECTRIC HEATING

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

TECHNOLOGY

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

AUTO WEIGHT TAX

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

BIRTH CONTROL

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

NUCLEAR ENERGY

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

INDUSTRIAL WATER USE

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

STRIP MINE

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

EMISSION CONTROL

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

FACTORY EFFLUENT

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

AGRICULTURAL PESTICIDE

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

COAL-FIRED POWER PLANT

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

SOLAR HEATING TAX BREAK

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

ENERGY ALTERNATIVE RESEARCH

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

BEST COPY AVAILABLE

55 MPH SPEED LIMIT

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

WOOD-BURNING STOVE

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

FOOD COLORING

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

NO SMOKING ZONE

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good

FUEL RATIONING

Wise _____:_____:_____:_____:_____:_____:_____: Foolisn

Bad _____:_____:_____:_____:_____:_____:_____: Good

FAMILY GARDEN

Wise _____:_____:_____:_____:_____:_____:_____: Foolish

Bad _____:_____:_____:_____:_____:_____:_____: Good